File Reference: EM.11.0057

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS No: 2008/06590

October 31, 2008

Suzanne Rainville, Forest Supervisor
Payette National Forest
800W Lakeside Ave
McCall, Idaho 83638-3602

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Goat Creek Culvert Replacement, Upper South Fork Salmon River, 1706020801, Valley County, Idaho (one project).

Dear Ms. Rainville:

The enclosed document contains a biological opinion (Opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to section 7(a)(2) of the Endangered Species Act (ESA) on the effects of the Goat Creek Culvert Replacement, as proposed by the Payette National Forest (PNF). In this Opinion, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of Snake River spring/summer Chinook salmon or Snake River Basin steelhead or result in the destruction or adverse modification of their designated critical habitat.

As required by section 7 of the ESA, NMFS provided an incidental take statement with the Opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal agency and any person who performs the action must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition.

This document also includes the results of our analysis of the action's likely effects on Essential Fish Habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes one conservation recommendation to avoid, minimize, or otherwise offset potential adverse effects on EFH. This conservation recommendation is an identical set of the ESA Terms and Conditions. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving this recommendation.

If the response is inconsistent with the EFH conservation recommendation, the PNF must explain why the recommendation will not be followed, including the justification for any disagreements over the effects of the action and the recommendation. In response to increased oversight of

overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

If you have questions regarding this consultation, please contact Ms. Sarah Fesenmyer (208) 378-5660 or Mr. Rick Edwards (208) 378-5645 in the Idaho State Habitat Office.

Sincerely,

for D. Robert Lohn
Regional Administrator

Enclosure

cc:

J. Foss – USFWS
J. Hansen – IDFG
R. Nelson – PNF
B. Elmo – Shoshone-Bannock Tribes
S. Penney – Nez Perce Tribe

Endangered Species Act – Section 7 Consultation
Biological Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Goat Creek Culvert Replacement, Upper South Fork Salmon River, 1706020801, Valley County, Idaho

Lead Action Agency: Payette National Forest

Consultation Conducted By: National Marine Fisheries Service
Northwest Region

Date Issued: October 31, 2008

Issued by:

for D. Robert Lohn
Regional Administrator

NMFS No.: 2008/06590

TABLE OF CONTENTS

TABLES AND FIGURES

ACRONYMS

BA	Biological Assessment
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
ICTRT	Interior Columbia Technical Review Team
IDFG	Idaho Department of Fish and Game
MPGs	Major Population Groups
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
Opinion	Biological Opinion
PCEs	Primary Constituent Elements
PFMC	Pacific Fishery Management Council
PNF	Payette National Forest
RPMs	Reasonable and Prudent Measures
SFSR	South Fork Salmon River
VSP	Viable Salmonid Population

1. INTRODUCTION

The biological opinion (Opinion) and incidental take statement portions of this consultation were prepared by the National Marine Fisheries Service (NMFS) in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, *et seq*.), and implementing regulations at 50 CFR 402. With respect to designated critical habitat, the following analysis relied only on the statutory provisions of the ESA, and not on the regulatory definition of "destruction or adverse modification" at 50 CFR 402.02.

The Essential Fish Habitat (EFH) consultation was prepared in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, *et seq*.) and implementing regulations at 50 CFR 600. The administrative record for this consultation is on file at the Idaho State Habitat Office.

1.1. Background and Consultation History

The Payette National Forest (PNF) proposes to replace a culvert on Goat Creek, in the Upper South Fork Salmon River, in order to allow fish passage between the South Fork Salmon River (SFSR) and potential habitat in Goat Creek. This project will give steelhead and Chinook salmon access to 1.5 miles of spawning and rearing habitat that has been inaccessible from the mainstem SFSR for many decades due to a perched culvert. The PNF proposed this project as part of a programmatic section 7 Watershed Biological Assessment (BA) for Ongoing and New Actions on the PNF in the SFSR, submitted to NMFS on April 22, 2008. NMFS will issue a letter of concurrence to address "Not Likely to Adversely Affect" actions included in this watershed BA, and will issue separate Opinions to address "Likely to Adversely Affect" actions included in the BA. This Opinion solely addresses the Goat Creek Culvert Replacement project. The Goat Creek project does not fit under NMFS' programmatic consultation on culvert replacements in Idaho conducted by the U.S. Forest Service or the Bureau of Land Management because the project has the potential to affect spawning listed fish and their redds (NMFS 2006a).

NMFS provided copies of the draft Opinion to the Nez Perce and Shoshone-Bannock Tribes on October 16, 2008. The Nez Perce Tribe responded with no comments on October 21, 2008, and the Shoshone-Bannock Tribe did not respond.

1.2. Proposed Action

The proposed action is the replacement of the Goat Creek culvert with an open-bottom structure to allow fish passage from the SFSR into the Goat Creek drainage. The Goat Creek crossing currently has a large culvert that is perched above the SFSR under typical flow conditions and acts as a migration barrier to salmon and steelhead. The existing culvert pipe was installed in 1953, and restoring passage to Goat Creek has long been a goal for the PNF.

The PNF proposes to replace the existing culvert pipe with an open-bottomed structure that simulates a natural stream profile. The open-bottomed structure will eliminate the passage barrier and increase the hydraulic capacity from 1,000 to 4,000 cubic feet per second. Before beginning the project, the PNF's contractor will dewater Goat Creek above the project site, rerouting the streamflow through a rigid pipe capable of containing high flows in the event of a storm. The contractor will then excavate the existing road fill over Goat Creek and remove the culvert pipe. A metal arch will be installed on concrete footings and stem walls; road fill will be replaced over the new structure; and a new road surface will be paved to a width of 14 feet. In order to route flow into the open-bottom structure, a new stream channel will be excavated, offset slightly from the old channel leading into the culvert pipe. The new channel and flood-prone area will be constructed and tied into Goat Creek at a location identified by a journey-level hydrologist or soil scientist. The contractor will wash the new Goat Creek stream channel and structure to remove sediment before reintroducing streamflow. Project implementation will begin in August and last through October.

Because this action will entail major ground disturbance in riparian areas, the PNF has incorporated multiple conservation measures into the action in order to minimize sediment delivery to Goat Creek and the SFSR. Conservation measures include the following stipulations:

- Prior to construction, Goat Creek will be diverted well above the culvert site in order to reduce the volume of seepage in the construction area and adequately dewater the site. The contractor will follow a Dewatering and Sediment Erosion Control Plan, which they will be required to submit to the PNF for approval.

- The contractor will place silt fences, straw bales, and other erosion control materials prior to the start of roadfill excavation and ground disturbance. Erosion control materials will be placed along both Goat Creek and the SFSR.

- The contractor will either construct a settling basin or install a portable basin to further prevent sediment loosened at the construction site from entering the SFSR. Ground water seepage into the new stream channel during construction will be pumped into the settling basin, where most suspended sediment will fall out before the water is pumped into the SFSR. The settling basin will be cleaned when full of sediment and the sediment transferred to one of two waste sites.

- Waste, excavated material, and sediment that has accumulated behind the existing culvert pipe will all be hauled offsite to one of two PNF landings. The contractor will submit an Excavation Plan to the PNF prior to project implementation. Most of the material to be reused for the new embankment will be stored temporarily at one of the two PNF offsite locations, but clean rocks may be temporarily stockpiled along the edges of Goat Creek.

- If fill areas are necessary along the creek, the fill will be covered with a geotextile fabric.

- Prior to introducing flow, the new channel will be washed to remove any excess fine material. SEDIMAT™ will be used to collect and remove fine sediment from the Goat Creek channel unless another method is approved by the PNF.

- Once Goat Creek is diverted into the new channel, a stable bank and channel at the point of diversion will be constructed. The bank will be adequately constructed to withstand the high stream energy associated with a bend in the channel that will result at the diversion point. The original Goat Creek channel will be plugged to ensure that the old channel does not recapture the creek during high flows.

- Sediment collected by straw bales and other erosion control methods will be removed to the extent possible without causing resource damage, as determined by a journey-level fishery biologist or hydrologist.

- All disturbed areas will receive mulch and seeding during the appropriate time of year for successful results, including the waste repositories.

- Erosion control materials will be removed by a journey-level hydrologist or soil scientist once areas of bare soil have revegetated.

- A journey-level hydrologist or soil scientist will monitor the project throughout implementation, including monitoring the effectiveness of erosion control measures.

- A journey-level fishery biologist, hydrologist, or soil scientist will review the contract package for the project prior to contract award to ensure that all mitigation items that are not being implemented by PNF crews are included in the contract package.

Besides erosion control measures, culvert replacement projects are designed to minimize adverse effects from fuels and lubricants, and from fish handling activities. Because the project will involve heavy machinery in riparian areas, there is a possibility that a fuel spill could occur and that harmful contaminants could enter Goat Creek or the SFSR. The contractor will therefore submit a Hazardous Spill Plan to the PNF which describes methods for avoiding fuel spills or leaks from heavy machinery and actions to take in event of a spill. The Hazardous Spill Plan will include such measures as refueling equipment outside of the riparian zone, storing and handling hazardous materials in safe areas, limiting shipments of fuel to the project site to 500 gallons per truck, and accompanying fuel delivery trucks on the SFSR Road with pilot vehicles and spill containment equipment. Fish handling conservation measures, on the other hand, are not needed for this project. The existing culvert is a fish passage barrier, blocking all upstream fish passage year-round. Therefore, no ESA-listed species are present in Goat Creek, so no individuals will be harmed when the lower stretch of the stream is dewatered prior to excavation.

The conservation measures described here and in the consultation initiation package as parts of the proposed action are intended to reduce or avoid adverse effects on listed species and their habitats. NMFS regards these conservation measures as integral components of the proposed action and expects that all proposed project activities will be completed consistent with those measures. We have completed our effects analysis accordingly. Any deviation from these conservation measures will be beyond the scope of this consultation and will not be exempted

from the prohibition against take as described in the attached incidental take statement. Further consultation will be required to determine what effect the modified action may have on listed species or designated critical habitats.

1.3. Action Area

'Action area' means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For purposes of this consultation, the action area is Goat Creek, from the upstream extent of project activities to its confluence with the SFSR; and the SFSR itself, from the Goat Creek confluence downstream 600 feet, the potential downstream extent of sediment plumes resulting from the project. Figure 1 shows Goat Creek in relation to the SFSR drainage.

The action area provides spawning, rearing, and migration habitat for both steelhead and summer Chinook salmon. The SRSR is designated critical habitat for both species, whereas the lower section of Goat Creek is designated critical habitat for Chinook salmon but not for steelhead, due to differences in how NMFS described critical habit for the two species (Table 1). Designated critical habitat for Snake River Basin steelhead includes specific reaches of streams and rivers, as published in the Federal Register (70 FR 52630), and Goat Creek is not included because the stream has been inaccessible to anadromous fish due to the perched culvert. Designated critical habitat for the Snake River spring/summer Chinook salmon, on the other hand, includes all river reaches presently or historically accessible to the species. This designation therefore includes the lower reaches of Goat Creek, which were historically accessible.

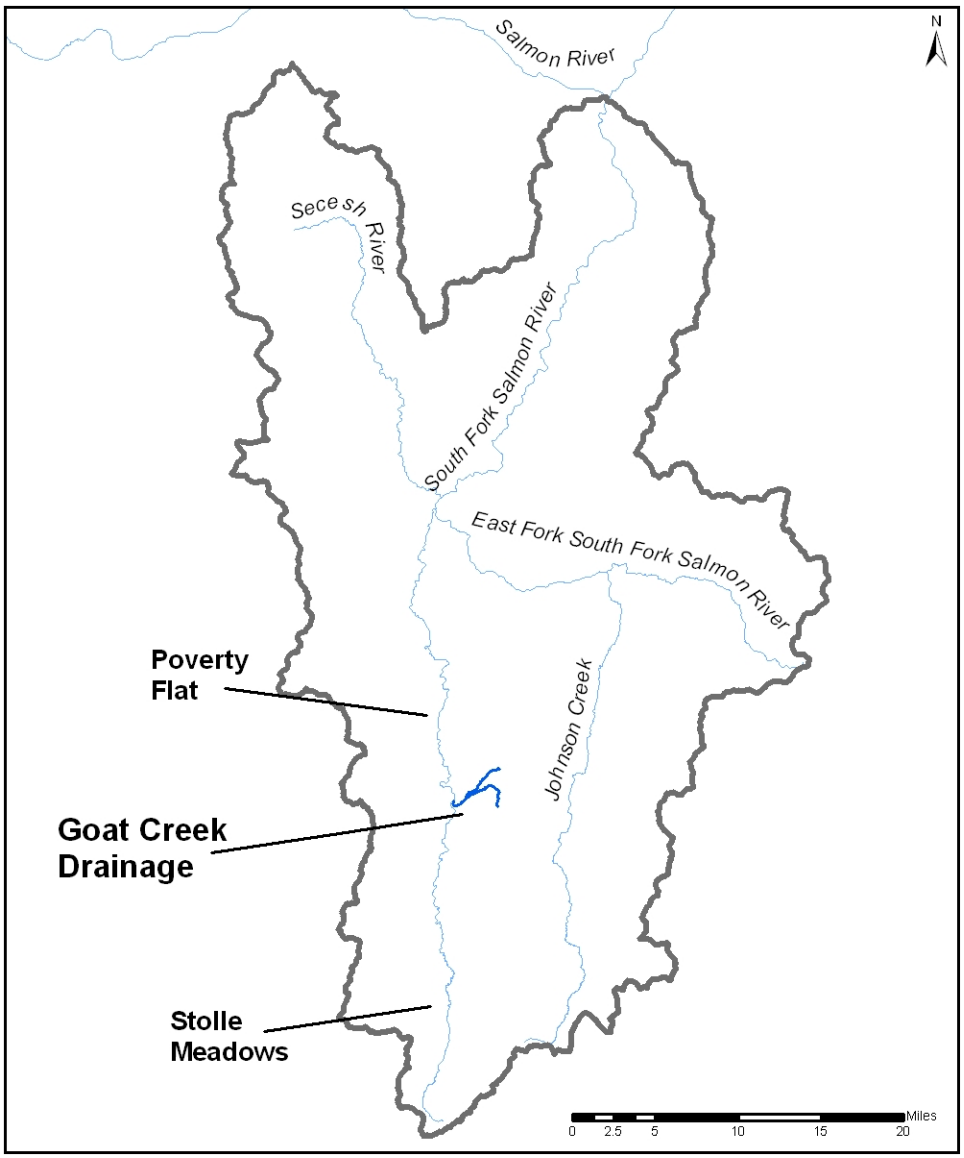
The action area is also EFH for Chinook salmon (PFMC 1999), and is in an area where environmental effects of the proposed project may adversely affect EFH for this species.

Table 1. Federal Register notices for final rules that list threatened and endangered species, designate critical habitats, or apply protective regulations to listed species considered in this consultation.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Snake River spring/summer run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Steelhead (*O. mykiss*)			
Snake River Basin	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160

Note: Listing status: 'T' means listed as threatened under the ESA.

Figure 1. South Fork Salmon River.



2. ENDANGERED SPECIES ACT

The ESA establishes a national program to conserve threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service, NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. Section 7(b)(4) requires the provision of an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) to minimize such impacts.

2.1. Biological Opinion

This Opinion presents NMFS' review of the status of each listed species of Pacific salmon and steelhead[1] considered in this consultation, the condition of designated critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects (50 CFR 402.14(g)). For the jeopardy analysis, NMFS analyzes those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected listed species.

The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated critical habitat for listed species by examining any change in the conservation value of the essential features of that critical habitat. This analysis relies on statutory provisions of the ESA, including those in section 3 that define "critical habitat" and "conservation," in section 4 that describe the designation process, and in section 7 that sets forth the substantive protections and procedural aspects of consultation. The regulatory definition of "destruction or adverse modification" at 50 CFR 402.02 is not used in this Opinion.

2.1.1. Status of the Species

This section defines the biological requirements of each listed species affected by the proposed action, and the status of each designated critical habitat relative to those requirements. Listed species facing a high risk of extinction and critical habitats with degraded conservation value are more vulnerable to the aggregation of effects considered under the environmental baseline, the effects of the proposed action, and cumulative effects. This section will describe the status of the two anadromous fish species in the action area, after first summarizing the species' population structure and viability criteria. The population structure and viability criteria provide a framework for evaluating the potential for species recovery and for evaluating how environmental effects in a particular watershed might translate to effects on a species.

ESU/DPS Structure

Salmonid biological structure is hierarchical. NMFS uses the concepts of Evolutionarily Significant Unit (ESUs) to define separate salmon species and uses Distinct Population Segment (DPSs) to define separate steelhead species. An ESU or DPS must be substantially reproductively isolated from other conspecific units and must also represent an important component of the evolutionary legacy of the species (Waples 1991). Within an ESU, independent populations can be grouped into larger aggregates that share similar genetic, geographic, or habitat characteristics (ICTRT 2003). These "major population groups" (MPGs) are groups of populations that are isolated from one another over a longer time scale than that defining the individual populations but which retain a degree of connectivity greater than that between ESUs. Finally, an individual population is a group of fish that spawn in the same

[1] An 'evolutionarily significant unit' (ESU) of Pacific salmon (Waples 1991) and a 'distinct population segment' (DPS) of steelhead (final steelhead FR notice) are considered to be 'species,' as defined in section 3 of the ESA.

stream, lake, or drainage at a particular season and that largely do not interbreed with any other group spawning in a different place or in the same place at a different season (McElhany et al. 2000).

Species Viability

The viability of an ESU or DPS depends on the viability of its component independent populations. NMFS reviews the range-wide status of the species affected by the proposed action using criteria that describe a "Viable Salmonid Population" (VSP) (McElhany et al. 2000). Attributes associated with a VSP include the abundance, productivity, spatial structure, and genetic diversity to enhance the population's capacity to adapt to various environmental conditions and allow it to become self-sustaining in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, characteristics that are influenced in turn by habitat and other environmental conditions.

Following this reasoning, the Interior Columbia Technical Review Team (ICTRT) drafted Population Viability Assessments for each population within an ESU, specifically examining the risk to each of the four parameters for VSP: population abundance, population productivity or growth rate, population spatial structure, and population life history and genetic diversity. These reports are available online at: http://www.idahosalmonrecovery.net. The ICTRT compared viability targets for the four parameters to current conditions in order to determine the overall extinction risk for each population. For example, viable populations should demonstrate sufficient productivity to support a net replacement rate of at least 1:1, and populations with low numbers of spawners should have a productivity level greater than 1:1 (greater than 1.0) to allow the population to return to abundance target levels. Population assessments are "rolled up" to arrive at risk assessments for the MPG and ESU levels. The ICTRT recommends that at least half of the populations in an MPG have a negligible risk of extinction and likewise that *all* MPGs be viable in order for the ESU as a whole to be viable (ICTRT 2007).

For Chinook salmon and steelhead in the SFSR, this section will now summarize the findings of the Population Viability Assessments (ICTRT 2006b and 2006c), the Draft Snake River Recovery Plan (NMFS 2008), and other relevant reports for each species.

2.1.1.1. Snake River Spring/summer Chinook Salmon

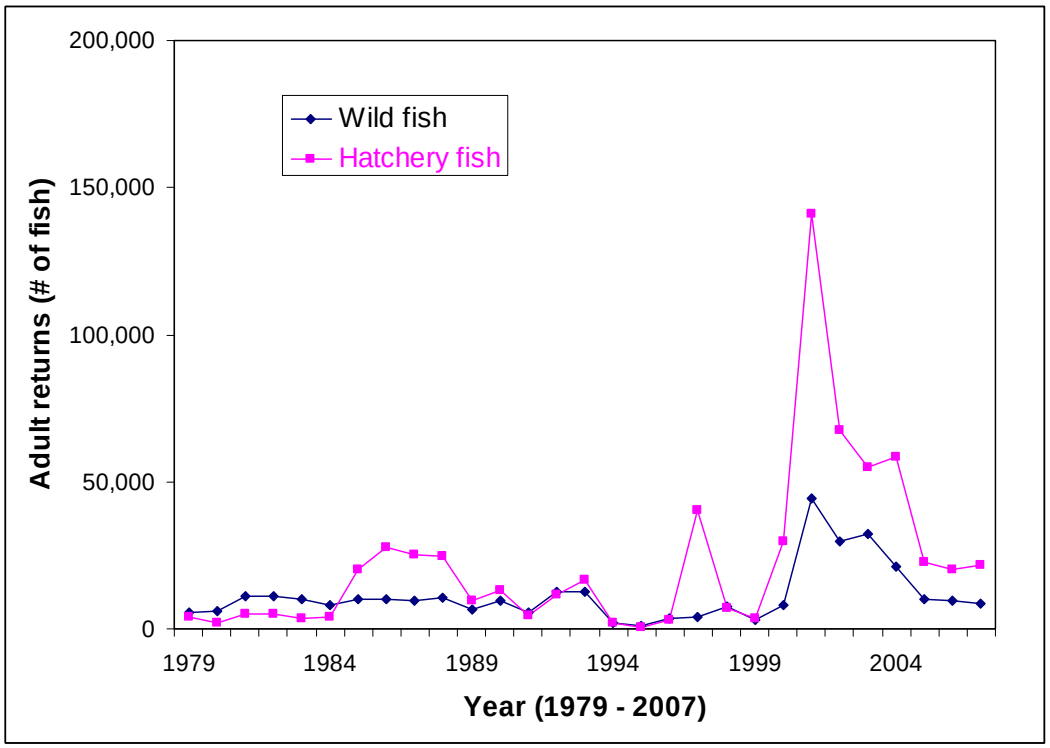
Spring and summer Chinook salmon runs returning to the major tributaries of the Snake River were classified as an ESU by NMFS in 1991 (Matthews and Waples). The Snake River spring/summer Chinook ESU includes current runs to the Tucannon River, the Grande Ronde River, the Imnaha River, and the Salmon River (Matthews and Waples 1991). Some or all of the fish returning to several of the hatchery programs are also listed, including those returning to the Tucannon River, Imnaha River, and Grande Ronde River hatcheries in Oregon and Washington, and to the Sawtooth, Pahsimeroi, and McCall hatcheries in Idaho. Historically, the Salmon River system in particular may have supported more than 40% of the total return of spring and summer Chinook to the Columbia River system (Fulton 1968). Within the Salmon River, the SFSR drainage was the main production area for summer-run Chinook.

Adult Snake River spring and summer Chinook enter the Columbia River on their upstream spawning migration from February through March and arrive at their natal tributaries from June through August. Spawning occurs in August and September. Juveniles exhibit a river-type life history strategy, rearing in their natal streams during their first summer of life before beginning their migration to the ocean the following spring. After reaching the ocean as smolts, the fish typically rear 2 to 3 years in the ocean before beginning their migration back to freshwater.

Snake River Spring/Summer Chinook ESU Trends

The historic total annual production of Snake River spring and summer Chinook may have been greater than 1.5 million adult returns per year (Matthews and Waples 1991). Returns to Snake River tributaries dropped to roughly 100,000 adults per year by the late 1960s (Fulton 1968). Since the 1970s, adult returns to the Snake River have been measured and estimated at Lower Granite Dam (Figure 2). Adult returns counted at Lower Granite Dam reached a low of 1,797 in 1995; numbers then increased considerably in 2001 to 2003; but abundance has again declined to just 8,730 adult returns in 2007 (IDFG data provided by Peter Hassemer, December 2007). Although wild returns were high from 2001 to 2003, abundance has remained extremely low for the last several decades in comparison to historic levels (Bevan et al. 1994).

Figure 2. Annual spring/summer Chinook salmon returns to Lower Granite Dam between 1979 and 2007 (Idaho Department of Fish and Game [IDFG] data provided by Peter Hassemer, December 2007).



As shown by Figure 2, artificial propagation has a large influence within the Snake River spring/summer Chinook salmon ESU. Of the 31 historic populations, 11 now include integrated hatchery programs with conservation goals, one has a non-ESU mitigation hatchery, and five populations have had some hatchery influence in the past but are currently being managed for natural production. In 2007, approximately 70% of the out-migrant adults returning to Lower Granite Dam were hatchery-origin. There is a mitigation hatchery program for the SFSR, based out of the McCall Hatchery.

South Fork Salmon River Population

Spring/summer Chinook salmon in the action area are part of the SFSR population of the SFSR MPG. The SFSR population is a summer-run, historically large population, with most spawning occurring in the mainstem of the SFSR itself. In order for the population to achieve viability, defined as a 95% probability of existence over 100 years, the population must have a minimum abundance of 1,000 spawners and a minimum productivity of 1.45 (ICTRT 2006b). However, the ICTRT recently calculated the 10-year geomean natural abundance to be only 556 returning adults, well below the minimum average threshold (ICTRT 2006b). Furthermore, the ICTRT calculated the 20-year average productivity (returns per spawner) to be only 0.90, again below the minimum productivity needed for population viability (ICTRT 2006b). Thus the SFSR Chinook population is not a viable population and is at high risk of extinction. The viability of this SFSR MPG is tied to the major summer-run production areas within the SFSR drainage, concentrated at Stolle Meadows and Poverty Flats on the mainstem SFSR (NMFS 2008).

The SFSR population must therefore achieve viability in order for the MPG to be viable, and in turn in order for the species to be viable. The SFSR population will need to see increases in both abundance and productivity. The primary way through which abundance and productivity could improve is through an increase in out-of-subbasin survival, such as in the Snake River migration corridor or during ocean residence, but improvements to spawning and rearing habitat within the SFSR watershed could also increase population viability (NMFS 2008). The key habitat limiting factor to salmonid production within the SFSR is fine sediment delivery to streams, with fish passage blocks a secondary limiting factor (NPCC 2004). If abundance and productivity are to increase in the SRSR, fine sediment delivery to streams must be minimized.

2.1.1.2. Snake River Basin Steelhead

The Snake River Basin steelhead DPS was first listed as threatened on August 18, 1997, (62 FR 43937), and after a status review was again listed as threatened on July 28, 2005. The Snake River DPS historically supported more than 55% of total steelhead production in the Columbia River Basin and continues to produce a large percentage. The DPS includes all naturally spawning populations of A-run and B-run steelhead in the Snake River and its tributaries. Snake River Basin steelhead spawn and rear in most tributaries used by Snake River spring/summer Chinook salmon as well as many additional smaller tributaries. The ICTRT (2003) identified six MPGs: the Grande Ronde River, Imnaha River, Clearwater River, Salmon River, Lower Snake River, and the Hells Canyon reach of the Snake River.

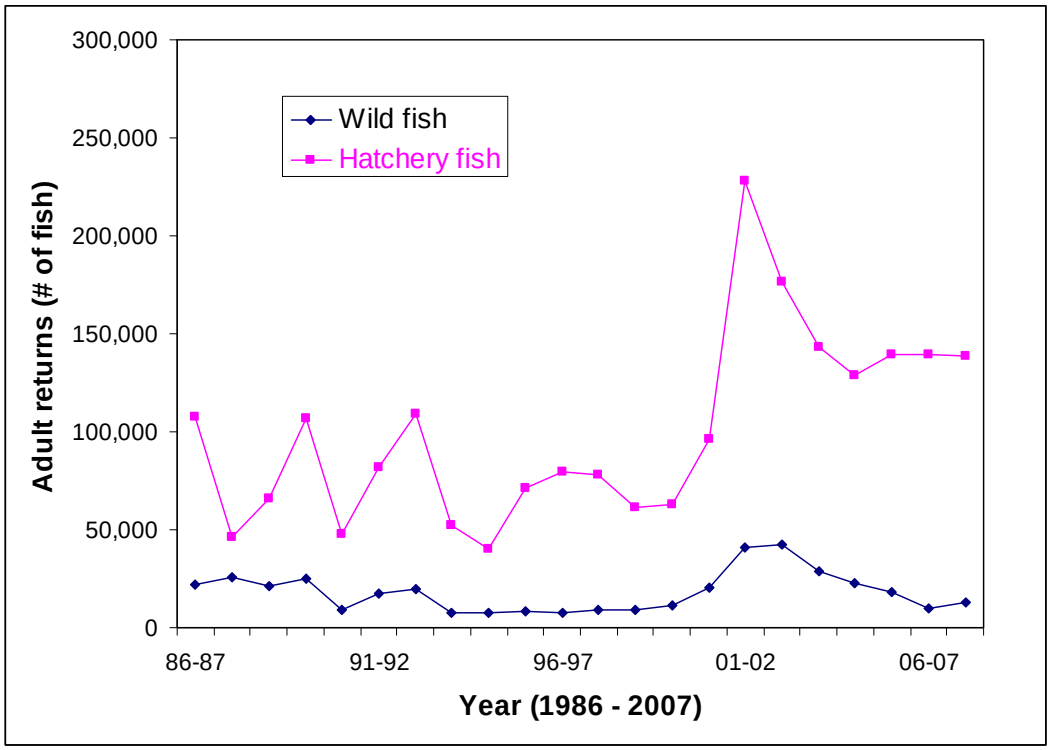
Adult Snake River Basin steelhead return to mainstem rivers from late summer through fall, where they hold in larger rivers for several months before moving upstream into smaller tributaries. Adult dispersal toward spawning areas varies with elevation, with the majority of adults dispersing into tributaries from March through May, with earlier dispersal at lower elevations and later dispersal at higher elevations. Spawning begins shortly after fish reach spawning areas, typically during a rising hydrograph but prior to peak flows (Thurow 1987). Steelhead typically select spawning areas at the downstream end of pools, in gravels ranging in size from 0.5 to 4.5 inches in diameter (Pauley et al. 1986). Juveniles emerge from redds in 4 to 8 weeks, depending on temperature. After emergence, fry have poor swimming ability and initially move from the redds into shallow, low-velocity areas in side channels and along channel margins in order to escape high velocities and predators (Everest and Chapman 1972). The young fish progressively move toward deeper water as they grow in size (Bjornn and Rieser 1991). Juveniles typically reside in fresh water for 2 to 3 years or longer depending on water temperature and growth rate (Mullan et al. 1992). Smolts in the Snake River basin migrate downstream during spring runoff, from March to mid-June depending on elevation.

Snake River Basin steelhead exhibit two distinct morphological forms, identified as "A-run" and "B-run" fish, which are distinguished by differences in body size, run timing, and length of ocean residence. B-run fish predominantly reside in the ocean for 2 years, while A-run fish typically spend only 1 year in the ocean. As a result of this difference, A-run steelhead are typically smaller than B-run steelhead, which allows A-run adults to spawn in smaller headwater streams and tributaries. The differences between the two fish stocks represent an important component of phenotypic and genetic diversity of the Snake River Basin steelhead DPS, exhibited through the asynchronous timing of ocean residence, segregation of spawning by stream size, and possible differences in the habitats the fish use in the ocean. SFSR steelhead are B-run.

Snake River Basin Steelhead DPS Trends

In reviewing steelhead status in Idaho, Busby et al. (1996) concluded that production of natural steelhead is now substantially below historic levels. Estimates of Snake River Basin steelhead abundance are not available prior to construction of the Ice Harbor Dam in 1962, at which time close to 116,000 wild and hatchery steelhead returned to the Snake River Basin (University of Washington 2005). Abundance dropped quickly in subsequent years as more dams were built on the Snake River. As shown in Figure 3, abundance of wild fish over the past 20 years has been well below the total estimate for 1962. Returns of hatchery fish have roughly doubled over the last 10 years, but wild fish have not shown the same increase. Wild fish returns did increase in 2001 and 2002, but that increase has not been sustained during the most recent years, and species abundance remains well below historic levels.

Figure 3. Annual steelhead returns to Lower Granite Dam between 1986 and 2007 (IDFG data provided by Peter Hassemer, December 2007).



South Fork Salmon River Population

Steelhead in the action area are part of the SFSR population of the Salmon River MPG. The SFSR population was historically of intermediate size. In order for the population to achieve viability, defined as a 95% probability of existence over 100 years, the population must achieve a minimum abundance of 1,000 spawners and a minimum productivity of 1.2 (ICTRT 2006c). While we do not have recent abundance and productivity statistics for the SFSR population in particular, the ICTRT (2006c) did generate estimates for an average Snake River B-run steelhead population, based on fish counts from Lower Granite Dam. The theoretical average Snake River B-run population has a 10-year geometric mean natural abundance of 272 spawners with a productivity of 0.85. Both of these estimates are below the minimum thresholds for viability, placing the SFSR steelhead population at high risk of extinction.

At least half of the populations in the steelhead Salmon River MPG must be viable in order for the MPG to be viable, and in turn in order for the species to be viable. The SFSR population must likely be one of those viable populations because of its genetic distinctiveness, historic B-run production potential, and lack of hatchery influence (NMFS 2008). The SFSR population will therefore need to see increases in both abundance and productivity. The primary way through which abundance and productivity could improve is through an increase in out-of-subbasin survival, such as in the Snake River migration corridor or during ocean residence, but improvements to spawning and rearing habitat within the SFSR subbasin could also increase population viability (NMFS 2008). The key habitat limiting factor to salmonid

production within the SFSR is fine sediment delivery to streams, with fish passage blockages a secondary limiting factor (NPCC 2004). If abundance and productivity are to increase in the SRSR, fine sediment delivery to streams must be minimized.

2.1.2. Status of Critical Habitat.

NMFS reviews the status of designated critical habitat affected by the proposed action by examining the condition and trends of primary constituent elements (PCEs) throughout the designated area. The PCEs consist of the physical and biological features identified as essential to the conservation of the listed species in the documents that designate critical habitat (Table 2). Since Chinook salmon and steelhead occupy many of the same geographic areas and have similar life history characteristics, their PCEs are also similar. The action area in the SFSR provides spawning, rearing, and migration habitat for both Chinook salmon and steelhead. The essential habitat features potentially affected by this action include substrate, water quality, and safe passage. Proper function of these essential features is necessary to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and the growth and development of juvenile fish.

Table 2. Types of sites and essential physical and biological features designated as PCEs, and the species life stage each PCE supports.

Site	Essential Physical and Biological Features	ESA-listed Species Life Stage
Snake River Steelhead[a]		
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity & floodplain connectivity to form and maintain physical habitat conditions	Juvenile growth and mobility
	Water quality and forage[b]	Juvenile development
	Natural cover[c]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[c]	Juvenile and adult mobility and survival
Snake River Spring/summer Chinook Salmon		
Spawning & Juvenile Rearing	Spawning gravel, water quality and quantity, cover/shelter, food, riparian vegetation, and space	Juvenile and adult.
Migration	Substrate, water quality and quantity, water temperature, water velocity, cover/shelter, food[d], riparian vegetation, space, safe passage	Juvenile and adult.

a Additional PCEs pertaining to estuarine, nearshore, and offshore marine areas have also been described for Snake River steelhead. These PCEs will not be affected by the proposed action and have therefore not been described in this Opinion.
b Forage includes aquatic invertebrate and fish species that support growth and maturation.
c Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
d Food applies to juvenile migration only.

Habitat impairment is common within the Snake River basin, affecting all life stages of both Chinook and steelhead, and all of the PCEs listed above. Many different human activities have degraded aquatic habitats and affected native fish populations throughout the Snake River. Impacts to fish habitat have come from stream channelization, elimination of wetlands, construction of water storage dams and levees, construction of roads (many with impassable culverts), timber harvest, mining, water withdrawals, unscreened water diversions, agriculture, livestock grazing, urbanization, outdoor recreation, fire exclusion/suppression, artificial fish propagation, fish harvest, and introduction of non-native species (Henjum *et al.* 1994; Rhodes *et al.* 1994; National Research Council 1996; Spence *et al.* 1996; and Lee *et al.* 1997). In many watersheds, land management and development activities have: (1) elevated fine sediment yields, degrading spawning and rearing habitat; (2) reduced large woody material that traps sediment, stabilizes streambanks, helps form pools, and provides cover; (3) reduced vegetative canopy that minimizes solar heating of streams; (4) reduced connectivity (*i.e.*, the flow of energy, organisms, and materials) between streams, riparian areas, floodplains, and uplands; (5) altered peak flow volume and timing, leading to channel changes and potentially altering fish migration behavior; (6) caused streams to become straighter, wider, and shallower, thereby reducing rearing habitat and increasing water temperature fluctuations; and (7) altered floodplain function, water tables and base flows (Henjum *et al.* 1994; McIntosh *et al.* 1994; Rhodes *et al.* 1994; Wissmar *et al.* 1994; National Research Council 1996; Spence *et al.* 1996; and Lee *et al.* 1997). These land uses have degraded PCEs including water quality, water quantity, spawning substrates, cover, forage, and safe passage.

Critical habitat was designated for Snake River spring/summer Chinook salmon on December 28, 1993 (58 FR 68543), and was revised on October 25, 1999 (64 FR 57399). Critical habitat is designated in the SFSR to include all river reaches presently or historically accessible to the species. Critical habitat includes the stream bottom, the water, and the adjacent riparian zone, which is defined as the area within 300 feet of the line of high water of a stream channel or from the shoreline of a standing body of water. Critical habitat important to the recovery of the species exists throughout the ESU. The Draft Recovery Plan for Snake River Salmon and Steelhead (NMFS 2008) calls for all populations to be maintained, thus requiring critical habitat with functioning PCEs for all populations, including the SFSR population.

Critical habitat for Snake River Basin steelhead was designated on September 2, 2005, with an effective date of December 31, 2005 (70 FR 52630). A map of critical habitat streams for steelhead is found at http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/upload/ID-CH-map.pdf. Designated critical habitat for the Snake River Basin steelhead includes only the stream channel, with a lateral extent as defined by the ordinary high-water line. The Snake River Basin Critical Habitat Analytical Review Team delineated steelhead critical habitat by watershed (5^{th}-field Hydrologic Unit) and rated each watershed as having high, medium, or low conservation value. The action area is in the Upper South Fork Salmon River watershed, which is rated as having high conservation value for steelhead.

2.1.3. Environmental Baseline

'Environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). An environmental baseline that does not meet the biological requirements of a listed species may increase the likelihood that adverse effects of the proposed action will result in jeopardy to a listed species or in destruction or adverse modification of a designated critical habitat.

NMFS describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support all life stages of each listed species within the action area. Both species considered in this Opinion reside in or migrate through the action area. Thus, for this action area, the biological requirements for salmon and steelhead are the habitat characteristics that support successful completion of spawning, rearing, and freshwater migration. The habitat features and biological requirements of the species likely to be affected by the proposed action are water quality, substrate, and safe passage. Concentrating on these PCEs, the following environmental baseline description will characterize fine sediment loads and passage blockages faced by the listed fish and designated critical habitat in the action area.

Fine sediment delivery to streams in the SFSR has the potential to limit salmonid production by adversely affecting redds, rearing juveniles, and migrating and spawning adult steelhead and Chinook salmon. Much of the South Fork watershed consists of heavily weathered granitic rock. This highly-erodible granitic rock breaks down into sandy material and has led to stream channels with a high percentage of sand-sized particles. However, road-building and timber harvest in the SFSR, which is forested and almost entirely managed by the U.S. Forest Service, have caused further increases in these natural high levels of fine particles within stream channels. In 1964 and 1965 a series of intense storms and rain-on-snow events created numerous landslides and slumps, triggered by logging and associated road construction, which inundated the SFSR and some of its tributaries with heavy sediment loads (USDA 2008). Spawning and rearing areas were buried under several feet of sand, destroying a major portion of the anadromous fish production area. Habitat conditions have recovered somewhat in recent years, due to natural processes, restoration activities initiated by the U.S. Forest Service, and a moratorium on large-scale logging (IDFG 1992). On the other hand, recent extensive wildfires burned much of the SFSR drainage, removing stabilizing vegetation from large expanses of the watershed and leaving the area again vulnerable to high rates of sediment delivery to streams. Elevated fine sediment inputs to streams could degrade spawning gravels and smother existing redds, fill in pools that provide juvenile rearing habitat, and expose juveniles and adults to elevated turbidity.

Fish passage impediments are a second factor currently affecting habitat in the SFSR. For example, the Goat Creek culvert has blocked passage from the SFSR into Goat Creek since it was installed in 1953. Since the culvert is located right at the mouth of the creek, it has blocked passage to the entire Goat Creek drainage. Replacing the culvert with a structure that allows fish passage will reconnect 12.8 miles of perennial stream to the South Fork mainstem (USGS 2008) and will reconnect 0.9 miles of potential steelhead spawning and rearing habitat (as modeled by

NMFS 2006d). The PNF estimates that replacing the structure will reconnect up to 1.5 miles of potential salmonid habitat above the culvert to the SFSR (USDA 2008). Goat Creek currently supports rainbow trout (USDA 2008), suggesting that the stream will also support steelhead spawning and rearing and possibly Chinook salmon rearing. As long as the old culvert remains in place, this passage blockage decreases the amount of available habitat for listed species in the SFSR.

2.1.4. Effects of the Action

'Effects of the action' means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Effects of the action that reduce the ability of a listed species to meet its biological requirements may increase the likelihood that the proposed action will result in jeopardy to that listed species or in destruction or adverse modification of a designated critical habitat.

Long-term adverse effects to ESA-listed fish and their habitat are not expected to occur as a result of the proposed action. Instead, this action is expected to benefit fish over the long-term by providing access to up to 1.5 miles of spawning and rearing habitat in Goat Creek, currently disconnected from the SFSR. NMFS does anticipate that installation of an open-bottom structure will have short-term adverse effects on water quality and substrate in the action area, and will create a short-term disturbance for listed fish present in the SFSR near the mouth of Goat Creek. Replacing the old culvert with a new open-bottom structure will involve major ground disturbance, potentially leading to the delivery of fine sediment to the lower section of Goat Creek and to the SFSR adjacent to and downstream of the project site. The PNF designed the action to include numerous conservation measures aimed at minimizing erosion at the project site, but some degree of sediment delivery to Goat Creek and the SFSR is inevitable with a construction project of this size. The following section will discuss the likely short-term adverse effects on fish from changes to water quality, stream substrate, and noise levels at the project site.

2.1.4.1. Water Quality

The proposed action could adversely affect water quality by increasing suspended sediment in the SFSR, or by delivering fuel or lubricants from heavy machinery to the water column.

Suspended Sediment

Turbidity can cause lethal, sublethal, or behavioral effects for juvenile and adult salmonids (Newcombe and Jensen 1996). Elevated suspended sediment has been linked to a number of behavioral and physiological responses in salmonids that indicate some level of stress such as gill flaring, coughing, avoidance, and increases in blood sugar levels (Bisson and Bilby 1982; Sigler et al. 1984; Berg and Northcote 1985; Servizi and Martens 1992). The magnitude of these stress responses is generally higher when turbidity is increased and particle size decreased (Bisson and Bilby 1982; Gregory and Northcote 1993). Although turbidity may

cause stress, Gregory and Northcote (1993) have shown that moderate levels of turbidity (35 to 150 nephelometric turbidity units) accelerate foraging rates among juvenile Chinook salmon, likely because of reduced vulnerability to predators due to camouflaging. Nonetheless, elevated levels of suspended sediment in the SFSR during and soon after project implementation could adversely affect adult and juvenile Chinook salmon and steelhead.

The PNF incorporated numerous conservation measures into the proposed action in order to minimize the potential for delivery of sediment to Goat Creek and to the SFSR, thus minimizing the potential exposure of listed species to elevated levels of suspended sediment (see section 1.2 of this Opinion). NMFS believes that these standard erosion prevention methods will minimize the amount of mobilized sediment that enters the SFSR but not eliminate sediment delivery. Despite erosion control measures such as silt fences and straw bales, some sediment from the excavation site may reach the SFSR during rain events, creating small short-term plumes of turbidity. A larger plume of turbidity is likely when flow is reintroduced to the new Goat Creek channel. Based on monitoring results from other culvert replacement projects, NMFS expects that the resulting sediment plume should be limited to less than 600 feet and should dissipate within a few hours, with water quality returning to background levels of suspended sediment after 24 hours (Casselli et al. 2000, Jakober 2002). This sediment plume will occupy only a portion of the SFSR channel since Goat Creek is a much smaller volume of water than the SFSR mainstem. The PNF reports that previous culvert replacements on the South Fork road have likewise led to very little sediment movement (USDA 2008).

Turbidity plumes from the Goat Creek project, while limited, may lead to take of listed fish. NMFS expects that fish present in the SFSR immediately downstream from the Goat Creek confluence will be able to avoid or reduce their exposure to turbidity by swimming to adjacent, less turbid habitat. Rearing juveniles are likely to avoid any sediment plumes, forcing them to temporarily seek alternate rearing areas. Take of juveniles may therefore occur through harm, as exposure of juveniles to predators will likely increase as they seek alternate rearing habitat. Spawning adults in close proximity to a sediment plume are also likely to move out of the plume until the water clears. The SFSR adjacent and immediately downstream of Goat Creek provides potential spawning habitat for Chinook salmon, so spawning adults could be exposed to increased levels of turbidity caused by the project. However, the largest sediment plume is expected in October, when flow is reintroduced to the Goat Creek channel and when Chinook salmon are no longer spawning. Because steelhead spawn in the spring and are not thought to spawn directly downstream of Goat Creek (NMFS 2006d), spawning steelhead will not be exposed to project-related turbidity. Take of adults due to increased turbidity is not expected to occur since adults are not at risk of increased predation and are unlikely to abandon a redd even if they temporarily move out of turbid conditions.

Chemical Contamination

Use of heavy machinery adjacent to stream channels poses the risk of an accidental spill of fuel, lubricants, hydraulic fluid, or similar contaminants into the riparian zone or directly into the water where these pollutants could adversely affect habitat, injure or kill aquatic food organisms, or directly impact ESA-listed species. Petroleum-based contaminants such as fuel, oil, and some hydraulic fluids contain poly-cyclic aromatic hydrocarbons, which can cause chronic sublethal effects to aquatic organisms (Neff 1985). Ethylene glycol, the primary ingredient in antifreeze,

has been shown to result in sublethal effects to rainbow trout at concentrations of 20,400 mg/L (Beak Consultants Ltd., 1995 as cited in Staples 2001). Brake fluid is also a mixture of glycols and glycol ethers, and has a similar toxicity to antifreeze.

Heavy machinery will be used throughout project implementation, but the majority of the work will occur on dry ground since Goat Creek will be dewatered at the project site. This aspect of the project design will limit the potential for fuels, lubricants, or other machinery-related contaminants to enter either Goat Creek or the SFSR. The PNF expects some ground water to seep into the dewatered Goat Creek channel, so contact between machinery and streamflow will be minimized but not eliminated. However, the Hazardous Spill Plan submitted by the contractor will further minimize the risk of fuel or oil leakage into the stream by incorporating such measures as refueling equipment outside of the riparian zone; storing and handling hazardous materials in safe areas; limiting shipments of fuel to 500 gallons per truck, and accompanying fuel trucks on the South Fork road with pilot vehicles and spill containment equipment. NMFS believes that if the contractor for the project follows a Hazardous Spill Plan approved by the PNF, these measures will effectively minimize the risk of negative impacts to ESA-listed fish and fish habitat from toxic contamination.

2.1.4.2. Sediment Deposition on Stream Substrate

Suspended sediment that enters the water column will fall out, increasing the amount of fine sediment on stream and river substrate. The methods for sediment introduction to Goat Creek and the SFSR were described in the suspended sediment discussion above. The same suite of conservation measures proposed to reduce the potential for suspended sediment will likewise minimize the potential for in-channel sediment deposition.

The potential effects of sediment deposition on fish habitat include smothering of redds and spawning gravels, reduction of available cover for juveniles, and changes to primary and secondary productivity. Egg-to-emergence survival and size of alevins is negatively affected by fine sediment intrusion into spawning gravel (Young et al. 1991). Fine sediment deposition in spawning gravel reduces the oxygen supply rate to redds (Wu 2000). Fine sediment delivery to streams can also reduce cover for juvenile salmonids (Bjornn and Reiser 1991). Fine sediment can fill pools as well as interstitial spaces in rocks and gravels used by fish for thermal cover and for predator avoidance (Waters 1995). Finally, fine sediment deposition can adversely affect primary and secondary productivity (Spence et al. 1996). Suttle et al. (2004) found that increases in fine sediment concentration led to a change from aquatic insects available to salmonids (surface grazers and predators) to unavailable burrowing species.

NMFS expects that almost all of the fine sediment delivered to the SFSR by sediment plumes from the project site will settle out on the river substrate within 600 feet downstream of the Goat Creek confluence. This assumption is based on monitoring results from other culvert replacement projects (Casselli et al. 2000, Jakober 2002). NMSF further expects that the limited amount of sediment deposited in this stretch of the SFSR will be flushed out within 9 months by high spring flows the following year. Project-related sediment introduced into the SFSR will be

small relative to the annual sediment budget of the river. Nonetheless, project-related sediment deposition may result in some of the effects described above to redds, juvenile cover, and aquatic insects:

- Chinook salmon redds built during project implementation could be exposed to fine sediment deposition. While most SFSR Chinook spawn in concentrated areas along the river such as Poverty Flat and Stolle Meadows, a lesser concentration of individuals spawn along much of the rest of the 44 miles of river upstream from the East Fork SFSR confluence. The IDFG conducts aerial surveys of the SFSR in order to count Chinook redds but does not record the exact location of redds. Thus we do not know if Chinook have built redds within 600 feet immediately downstream of the Goat Creek confluence in recent years (Kim Apperson, IDFG, personal communication with Sarah Fesenmyer, NMFS, 10-14-08). Although not a known spawning reach, the action area nonetheless contains potential spawning habitat, and the action will take place during Chinook spawning season. Sediment from the project site may therefore fall out of the water column onto redds, reducing the survival rate of the eggs. However, the likelihood of this occurring is minimal because any sediment plumes from the project site will remain close to the bank of the SFSR, given the small amount of flow in Goat Creek relative to the SFSR. Any redds in the area are likely to be in pool tailouts closer to the middle of the channel, where local hydraulics ensure that spawning gravels are well aerated.

- Steelhead redds will not be exposed to sediment deposition given the timing and location of the project.

- NMFS expects that juvenile cover will be affected in the short-term in the SFSR for no more than 600 feet downstream of the Goat Creek confluence, but that habitat quality will then recover as fine sediments are flushed downstream during high flows after project completion. Any loss of juvenile habitat that occurs from sediment deposition caused by the proposed action is likely to be temporary, confined to the project area, and thus not have any long-term effects on ESA-listed fish.

- Finally, NMFS expects that any effects to primary production in the SFSR will be insignificant due to the conservation measures included in the action to minimize sediment delivery.

2.1.4.3. Fish Disturbance

Construction activities will temporarily disrupt and disturb listed species present in the mainstem SFSR immediately upstream and downstream from the Goat Creek culvert, from August until November when the project is completed. Noise from excavation and construction could disturb Chinook salmon migrating up the SFSR past the Goat Creek confluence or spawning in the SFSR immediately downstream of the culvert. Excavation and construction noise could also adversely disturb rearing juveniles in the SFSR near the project site. Noise from heavy equipment operating adjacent to live water may disturb fish in the immediate vicinity causing short-term displacement. However, flight and avoidance responses such as this constitute typical

fish response behavior to natural perturbations. Consequently, although periodic noise from project activities may disturb individual fish, NMFS does not expect these disturbances to result in individual mortality or to prevent adults from spawning in the SFSR near the Goat Creek confluence or from migrating upstream past the project site to reach upstream spawning grounds.

2.1.4.4. Relevance of Effects to Species Viability

The effects on individual fish and fish habitat summarized above may in turn affect the attributes associated with a VSP; the levels of abundance, productivity, spatial structure, and diversity that support a species' ability to maintain itself naturally and to survive environmental stochasticity. As shown in the analysis above, potentially significant effects on individual fish and habitat in the action area include exposure to turbidity and sediment. Small amounts of sediment deposition and turbidity will have no effect on spatial structure or genetic diversity. Similarly, NMFS expects that sediment and turbidity exposure will have only a very small effect on the abundance and productivity of the individual populations in the action area, given the small extent of the sediment-related project effects in comparison to total miles of habitat in both the Chinook salmon and steelhead SFSR populations. The greatest risk that the project poses to the abundance and productivity of the action area's populations is the risk of exposure of Chinook redds built below the Goat Creek confluence to fine sediment deposition. If in the path of sediment plumes from the project, such redds may see reduced egg-to-emergence survival. However, given that most Chinook spawning for the SFSR population occurs in concentrated areas of the river not near the Goat Creek confluence, and given the small spatial extent of likely sediment deposition on SFSR substrate, NMFS does not expect the action to affect abundance and productivity at the population level. Because the action will increase available habitat for listed species, abundance may slightly improve for future generations within each population, particularly for SFSR steelhead. The effects of the action are therefore not likely to negatively affect VSP criteria at the population level and hence not likely to reduce the viability of the MPGs, the Chinook salmon ESU, or the steelhead DPS.

2.1.4.5. Effects to Critical Habitat

NMFS designates critical habitat based on physical and biological features that are essential to the listed species. Essential features for designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space and safe passage. The action area provides spawning, rearing, and freshwater migration habitat for Snake River spring/summer Chinook salmon and Snake River Basin steelhead. The critical habitat essential features associated with spawning, rearing, and freshwater migration that may be adversely affected by the action are water quality and substrate, as discussed in detail above.

1. **Water Quality.** As described above, water quality in the SFSR may be temporarily degraded due to increased turbidity from the replacement of the Goat Creek culvert. Conservation measures included in the action will minimize sediment delivery. Based on monitoring results from other culvert replacement projects, NMFS expects that sediment plumes resulting from the project, and in particular from reintroducing

flow to the Goat Creek channel at project completion, should be limited to less than 600 feet and should dissipate within a few hours, with water quality returning to background levels of suspended sediment after 24 hours (Casselli et al. 2000; Jakober 2002).

2. **Substrate.** As described above, temporary pulses of sediment and turbidity plumes are expected to cause downstream fine sediment deposition, negatively affecting substrate in the SFSR in the short-term. However, NMFS expects this temporary increase to be small in comparison to the annual sediment load during peak discharge and to be flushed out during high flows the following year.

Implementation of the proposed action is expected to cause some short-term impairment to PCEs in the action area due to temporary sediment impacts on turbidity levels and substrate. Based on the effects described above, it is reasonably likely that the proposed action will have negative impacts on the conservation value of critical habitats from the time of project initiation until the next peak discharge (about seven months). Critical habitat in the action area is of high conservation value and is vulnerable to degradation of PCEs from high loads of fine sediment. However, the amount of fine sediment likely to be added to the SFSR from the project site is small relative to the river's annual sediment load. In the long-term, NMFS expects the proposed action to provide improvements to critical habitat for both steelhead and Chinook by increasing safe passage and access to habitat in Goat Creek. The conservation value of critical habitat in the action area and at the species level is therefore likely to improve as a result of the Goat Creek culvert replacement project.

2.1.4.6. Cumulative Effects

'Cumulative effects' are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Cumulative effects that reduce the ability of a listed species to meet its biological requirements may increase the likelihood that the proposed action will result in jeopardy to that listed species or in destruction or adverse modification of a designated critical habitat.

The action area contains Federal lands administered by the PNF. The land upstream from the project site is also Federal land, administered by the PNF and the Boise National Forest. Therefore, NMFS does not expect cumulative effects in the action area from future state or private activities.

2.1.5. Conclusion

After reviewing the status of spring/summer Chinook salmon and steelhead, their designated critical habitats, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS concludes that the action, as proposed, is not likely to jeopardize

the continued existence of Snake River spring/summer Chinook salmon and steelhead and is not likely to destroy or adversely modify Snake River spring/summer Chinook salmon and steelhead designated critical habitat. These conclusions are based on the following considerations:

- The Goat Creek culvert replacement will have a long-term positive effect on steelhead and salmon by increasing available habitat in the SFSR.

- Because of proximity to the SFSR and the current and historic vulnerability of salmonid habitat in the watershed to degradation from fine sediment inputs, the PNF included numerous conservation measures in the action to minimize the delivery of sediment to the river.

- The action will lead to a short-term increase in turbidity in the SFSR, but water quality will not be affected in the long-term because construction effects will be brief, localized, and transitory. Temporary pulses of turbidity in the SFSR from reintroducing streamflow into the Goat Creek channel or from rain events are likely to extend up to 600 feet downstream from Goat Creek. Individual fish present within 600 feet are likely to migrate out of the most turbid waters thereby avoiding the highest levels of sublethal effects.

- The action will lead to short-term negative effects to fish from fine sediment deposition on substrate in the SFSR. NMFS expects that almost all of the fine sediment delivered to the SFSR by sediment plumes from the project site will settle out on river substrate within 600 feet downstream of the Goat Creek confluence. NMFS further expects that most of this sediment will be flushed downstream during spring flows the following year. If sediment is deposited on any Chinook redds immediately downstream of Goat Creek, these redds could see a reduction in egg survival. Yet because few, if any, redds might be exposed to sediment, only a small fraction of Chinook eggs within the population could potentially be harmed. This fraction is too small to affect the abundance and productivity of the SFSR Chinook population.

2.1.6. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. The following recommendation is a discretionary measure that NMFS believes is consistent with this obligation and therefore should be carried out by the PNF.

1. Periodically survey Goat Creek to determine whether or not spawning and rearing steelhead or Chinook salmon has occupied the drainage once the culvert is replaced and fish passage restored.

Please notify NMFS if the PNF carries out this recommendation so that we will be kept informed of actions that minimize or avoid adverse effects and those that benefit listed species or their designated critical habitats.

2.1.7. Reinitiation of Consultation

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) if new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not previously considered; (c) if the identified action is subsequently modified in a manner that has an effect to the listed species or designated critical habitat that was not considered in the Opinion; or (d) if a new species is listed or critical habitat is designated that may be affected by the identified action (50 CFR 402.16).

To reinitiate consultation, contact the Idaho State Habitat Office of NMFS and refer to NMFS Number assigned to this consultation.

2.2. Incidental Take Statement

Section 9(a)(1) of the ESA prohibits the taking of endangered species without a specific permit or exemption. Protective regulations adopted pursuant to section 4(d) extend the prohibition to threatened species. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 CFR 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

2.2.1. Amount or Extent of Take

The proposed action is reasonably certain to result in incidental lethal and non-lethal take of steelhead and Chinook salmon during project implementation. NMFS is reasonably certain that the incidental take described here has occurred because: (1) Snake River Basin steelhead and summer Chinook salmon are known to occur in the action area during the project's work window; and (2) the project includes riparian and in-channel work that may generated turbidity plumes in the SFSR extending up to 600 feet downstream from the work site.

Take caused by altered habitat conditions cannot be accurately quantified as a number of fish. This is because the relationship between habitat-related effects and the distribution and abundance of fish in the action area is imprecise, such that NMFS cannot predict a specific number of individuals taken. In such circumstances, NMFS uses the causal link established between the activity and a change in habitat conditions affecting the species to describe the extent of take. In this case, the extent of take will be described as the extent of turbidity and sediment deposition caused by the proposed action. The extent of take authorized in association with the proposed action is therefore turbidity above background levels in the SFSR extending 600 feet downstream of the Goat Creek confluence. The extent of take will be exceeded if

turbidity is visible above background levels at 600 feet downstream of the in-stream work. Background turbidity levels should be observed at least 200 feet upstream from the proposed work site.

2.2.2. Reasonable and Prudent Measures

The RPMs are nondiscretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The PNF has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) will lapse if the PNF fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions. Similarly, if any applicant fails to act in accordance with the terms and conditions of the incidental take statement, protective coverage will lapse.

NMFS believes that full application of conservation measures included as part of the proposed action, together with use of the RPM and the term and condition described below, is necessary and appropriate to minimize the likelihood of incidental take of listed species due to completion of the proposed action.

The PNF shall:

1. Ensure completion of a monitoring and reporting program to confirm that the conservation measures included in the proposed action are effective in avoiding and minimizing incidental take from permitted activities.

2.2.3. Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the PNF and its cooperators, including the applicant, if any, must fully comply with conservation measure described as part of the proposed action and the following term and condition that implement the RPM described above. Partial compliance with this term and condition may invalidate this take exemption, result in more take than anticipated, and lead NMFS to a different conclusion regarding whether the proposed action will result in jeopardy or the destruction or adverse modification of designated critical habitats.

1. To implement RPM #1, the PNF shall:

   Conduct visual monitoring to confirm that the extent of take (600 foot sediment plume) is not exceeded. Notify NMFS of monitoring results within one month.

   (a) Complete post-project monitoring after the first high streamflow event to verify that erosion control measures are in place and effective and that the

new channel is functioning as expected. Notify NMFS of monitoring results within one month. If erosion control measures are found not to be effective or the new channel is not functioning as expected, the PNF shall notify NMFS immediately.

(b) NOTICE. If a steelhead or salmon becomes sick, injured or killed as a result of project-related activities, and if the fish would not benefit from rescue, the finder should leave the fish alone, make note of any circumstances likely causing the death or injury, location and number of fish involved, and take photographs, if possible. If the fish in question appears capable of recovering if rescued, photograph the fish (if possible), transport the fish to a suitable location, and record the information described above. Adult fish should generally not be disturbed unless circumstances arise where an adult fish is obviously injured or killed by proposed activities, or some unnatural cause. The finder must contact the Boise Field Office of NMFS Law Enforcement at (208) 321-2956 as soon as possible. The finder may be asked to carry out instructions provided by Law Enforcement to collect specimens or take other measures to ensure that evidence intrinsic to the specimen is preserved.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirement of section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect EFH. Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council (PFMC) designated EFH for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of Snake River spring/summer Chinook salmon. Based on information provided in the BA and the analysis of effects presented in the ESA portion of this document, NMFS concludes that proposed action will have minor water quality impacts on EFH including temporary increases in turbidity and localized sediment deposition extending up to 600 feet downstream in the SFSR from the project site.

3.1. EFH Conservation Recommendations

NMFS believes that the implementation of the RPM and the term and condition described in sections 2.2.2 and 2.2.3 is necessary to avoid, mitigate, or offset the impact of the proposed action on EFH. This Conservation Recommendation is identical to the ESA Term and Condition.

3.2. Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendation within 30 days of receipt of this recommendation [50 CFR 600.920(j) (1)]. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse affects of the activity on EFH. If the response is inconsistent with the EFH conservation recommendation, the response must explain the reasons for not following the recommendation. The reasons must include the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

3.3. Supplemental Consultation

The PNF must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(k)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act [DQA]) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users.

This ESA consultation concludes that the proposed Goat Creek culvert replacement will not jeopardize the affected listed species. Therefore, the USFS can authorize, fund, and carry out this action. The intended user of this consultation is the PNF.

Individual copies were provided to the above-listed entities. This consultation will be posted on NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01, *et seq.*, and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the Literature Cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

5. LITERATURE CITED

Berg, L., and T.G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (Oncorhynchus kisutch) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Science 42: 1410-1417.

Bevan, D., J. Harville, P. Bergman, T. Bjornn, J. Crutchfield, P. Klingeman, and J. Litchfield. 1994. Snake River Salmon Recovery Team: Final Recommendations to National Marine Fisheries Service (NMFS).

Bisson, P.A., and R.E. Bilby. 1982. Avoidance of suspended sediment by juvenile coho salmon. North American Journal Fisheries Management 4: 371-374.

Bjornn, T. and D. Reiser. 1991. Salmonid Distributions and Life Histories. American Fisheries Society Special Publication 19:83-138.

Busby, P., T. Wainwright, G. Bryant, L. Lierheimer, R. Waples, F. Waknitz, and I. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Oregon and California. NOAA Technical Memorandum NMFS-NWFSC-27. National Marine Fisheries Service: Seattle, Washington. Available online: http://www.nwr.noaa.gov/Publications/Biological-Status-Reviews/upload/SR1997-steelhead0.pdf

Casselli, J., B. Riggers, and A. Rosquist. 2000. Seigel Creek Culvert Removal, Water Monitoring Report. Lolo National Forest, Missoula, MT. 9 pgs.

Everest, F.H. and D.W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. Journal of the Fisheries Research Board of Canada 29(1): 91-100.

Fulton, L.A. 1968. Spawning areas and abundance of chinook salmon, Oncorhynchus tshawytscha, in the Columbia River Basin—past and present. U.S. Fish and Wildlife Service Special Science Report—Fisheries No. 571. Washington, D.C.

Gregory, R.S., and T.S. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile chinook salmon (Oncorhynchus tshawytscha) in turbid laboratory conditions. Canadian Journal of Fisheries and Aquatic Sciences 50: 223-240.

Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries and watersheds. National Forests east of the Cascade Crest, Oregon and Washington. A Report to the United States Congress and the President. The Wildlife Society, Bethesda, MD.

ICTRT (Interior Columbia Technical Review Team). 2003. Independent Populations of chinook, steelhead and sockeye for listed Interior Columbia Basin ESUs, Draft. Interior Columbia Basin Technical Recovery Team Report, July 2003. Northwest Fisheries Science Center, National Marine Fisheries Service: Seattle, Washington. Available online: http://www.nwfsc.noaa.gov/trt/trt_columbia.cfm

ICTRT. 2006b. South Fork Salmon River Summer Chinook Salmon Population Viability Assessment. Northwest Fisheries Science Center, National Marine Fisheries Service: Seattle, Washington. Available online: http://www.idahosalmonrecovery.net/pdfs/PVA5362_SFSRMain_chRev.pdf

ICTRT. 2006c. South Fork Salmon River Steelhead Salmon Population Viability Assessment. Northwest Fisheries Science Center, National Marine Fisheries Service: Seattle, Washington. Available online: http://www.idahosalmonrecovery.net/pdfs/PVA_7_5_6_3_South_Fork_Salmon_stlhd092006.pdf

ICTRT. 2007. Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs, Draft. Northwest Fisheries Science Center, National Marine Fisheries Service: Seattle, Washington. Available online: http://www.nwfsc.noaa.gov/trt/trt_documents/ictrt_viability_criteria_reviewdraft_2007_body.pdf

IDFG (Idaho Department of Fish and Game). 1992. Anadromous Fish Management Plan: 1992-1996. IDFG: Boise, Idaho.

Jakober, M. J. 2002. Sheep Creek Culvert Replacement Sediment Monitoring, Bitterroot National Forest. Monitoring Report, 6 pgs.

Lee, D.C, and 20 co-authors. 1997. Broadscale assessment of aquatic species and habitats. In: Quigley, Thomas M.; Arbelbide, Sylvia J., tech. eds. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins: Volume III. Gen. Tech. Rep. PNW-GTR-405. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Matthews, G.M., and R.S. Waples. 1991. Status review for Snake River spring and summer chinook salmon. NMFS F/NWC/-200. Available from NOAA Fisheries, Northwest Fisheries Science Center, Coastal Zone and Estuaries Studies Division, 2725 Montlake Blvd., E., Seattle, Washington 98112-2097.

McElhany, P., M. Ruckleshaus, M. J. Ford, T. Wainwright, and E. Bjorkstedt. 2000. Viable Salmon Populations and the Recovery of Evolutionarily Significant Units. U. S. Department of Commerce, National Marine Fisheries Service, Northwest Fisheries Science Center, NOAA Technical Memorandum NMFS-NWFSC-42. 156 p. http://www.nwfsc.noaa.gov/publications/techmemos/tm42/tm42.pdf

McIntosh, B.A., J.R. Sedell, J.E. Smith, R.C. Wissmar, S.E. Clarke, G.H. Reeves, and L.A. Brown. 1994. Management history of eastside ecosystems: Changes in fish habitat over 50 years, 1935 to 1992. USDA Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-321.

Mullan, J.W., Williams, K.R., Rhodus, G., Hillman, T.W. and J.D. McIntyre. 1992. Production and habitat of salmonids in mid-Columbia River tributary streams. U.S. Fish and Wildlife Service Monograph I: 1-489. Leavenworth, Washington.

National Research Council. 1996. Upstream Salmon and society in the Pacific Northwest. National Academy Press, Washington, D.C.

Neff, J.M. 1985. Polycyclic aromatic hydrocarbons. In: Fundamentals of aquatic toxicology, G.M. Rand, and S.R. Petrocelli (eds.), pp. 416-454. Hemisphere Publishing, Washington, D.C.

Newcombe, C. P., and J. O. Jensen. 1996. Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. North American Journal of Fisheries Management 16(4): 693-727.

NMFS (National Marine Fisheries Service). 2006a. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Stream Crossing Structure Replacement and Removal Activities, Snake and Clearwater River Basins. National Marine Fisheries Service: Boise, Idaho.

NMFS. 2006d. Interior Columbia Basin Stream Type Chinook Salmon and Steelhead Populations: Habitat Intrinsic Potential Analysis, Draft. Northwest Fisheries Science Center, National Marine Fisheries Service: Seattle, Washington.

NMFS. 2008. Draft Recovery Plan for Snake River salmon and steelhead. NMFS: Boise, Idaho. Available online at: http://www.idahosalmonrecovery.net/index.html.

NPCC (Northwest Power and Conservation Council). 2004. Salmon Subbasin Assessment, Prepared for the Northwest Power and Conservation Council by Idaho Department of Fish and Game.

Pauley, G.B., B.M. Bortz, and M.F. Shepard. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest) -- steelhead trout. U.S. Fish and Wildlife Service Biological Report 82(11.62). U.S. Army Corps of Engineers, TR EL-82-4. 24 p.

PFMC (Pacific Fishery Management Council). 1998a. Final Environmental Assessment/ Regulatory Review for Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon (October 1998). http://www.pcouncil.org/groundfish/gffmp/gfa11.html

PFMC (Pacific Fishery Management Council). 1998b. The Coastal Pelagic Species Fishery Management Plan: Amendment 8. Pacific Fishery Management Council, Portland, Oregon (December 1998). http://www.pcouncil.org/cps/cpsfmp.html

PFMC (Pacific Fishery Management Council). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Pacific Fishery Management Council, Portland, Oregon (March 1999). http://www.pcouncil.org/salmon/salfmp/a14.html

Rhodes, J.J., D.A. McCullough, and F.A. Espinosa, Jr. 1994. A coarse screening process for potential application in ESA consultations. Columbia River Intertribal Fish Commission. Prepared under NMFS/BIA Inter-Agency Agreement 40ABNF3.

Servizi, J.A., and D.W. Martens. 1992. Sublethal responses of coho salmon (Oncorhynchus kisutch) to suspended sediments. Canadian Journal of Fisheries and Aquatic Sciences 49: 1389-1395.

Sigler, J., T.C. Bjornn, and F.H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Transactions of the American Fisheries Society 113:142-150.

Spence, B.C, G.A. Lomnicky, R.M. Hughes, R.P. Novitzki. 1996. An Ecosystem Approach to Salmonid Conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon. (December 1996). http://www.nwr.noaa.gov/1habcon/habweb/habguide/ManTech/front.htm

Staples C.A, Williams J.B., Craig G.R., Roberts K.M. 2001. Fate, effects and potential environmental risks of ethylene glycol: a review. Chemosphere. 43(3): 377-383.

Suttle, K.B., M.E. Power, J.M. Levine and C. McNeely. 2004. How fine sediment in riverbeds impairs growth and survival of juvenile salmonids. Ecological Applications. 14(4):969-974.

Thurow, R. 1987. Evaluation of the South Fork Salmon River steelhead trout fishery restoration program. Lower Snake River Fish and Wildlife Compensation Plan. Job Completion Report, Contract No. 14-16-0001-86505, Idaho Department of Fish and Game: Boise, Idaho.

U.S. Geological Survey. 2008. National Hydrography Dataset (NHD), vector data. U.S. Geological Survey, Reston, Virginia. Available online: http://nhd.usgs/gov

University of Washington. 2005. DART Adult Passage Composite Report. Columbia Basin Research, School of Aquatic & Fishery Sciences, University of Washington. Online Query: June 12, 2008, http://www.cbr.washington.edu/dart/adult.html.

U.S. Department of Agriculture . 2008. Biological Assessment for the Potential Effects of Managing the Payette National Forest in the South Fork Salmon River Section 7 Watershed on Snake River Spring/Summer Chinook Salmon, Snake River Steelhead, and Columbia River Bull Trout and Biological Evaluation for Westslope Cutthroat Trout. Volume 28, Ongoing and New Actions. Payette National Forest. McCall, Idaho.

Waples, R.S. 1991. Definition of 'Species' Under the Endangered Species Act: Application to Pacific Salmon. U.S. Department of Commerce, National Marine Fisheries Service, Northwest Fisheries Science Center, NOAA Technical Memorandum NMFS- F/NWC-194. http://www.nwfsc.noaa.gov/publications/techmemos/tm194/waples.htm

Waters, T.F. 1995. Sediment in Streams: sources, biological effects, and control. American Fisheries Society Monograph 7. 1995.

Wissmar, R.C., J.E. Smith, B.A. McIntosh, H.W. Li, G.H. Reeves, and J.R. Sedell. 1994. Ecological health of river basins in forested regions of eastern Washington and Oregon. Gen. Tech. Rep. PNW-GTR-326. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR. 65 p.

Wu, F-C. 2000. Modeling embryo survival affected by sediment deposition into salmonid spawning gravels: Application to flushing flow prescriptions. Water Resources Research 36(6):1595-1606.

Young, M.K., Hubert, W.A., and Wesche. T.A. 1991. Selection of measures of substrate composition to estimate survival to emergence of salmonids and to detect changes in stream substrates. North American Journal of Fisheries Management 11: 339-346.